grounds on which we may assume that the so-called Saint Acheul flint instruments, found in alluvial beds of undoubted Quaternary origin, supply the most ancient testimony of man's presence on the surface of the earth. While attaching great importance to the careful elucidation of the chronological order in which the oldest traces of man appear relatively to the different series of the Quaternary formations, he points out the imminent risk of losing the few opportunities which still remain of studying this connection between the objects found and the nature and order of sequence of the beds in which they were deposited, owing to the most interesting finds having long been made to swell the collections of our Museums without reference to their value as exponents of the problems of our primitive history. M. Marcellin Boule considers that palæologists have erred in assuming that all beds containing the same fossil remains must necessarily belong to the same epoch, and that sufficient importance has not been attached to the fact that the same deposit often contains a mixture of animal forms belonging both to so-called northern and southern types. In explanation of these and many other anomalous phenomena, he thinks we may derive important help from a careful consideration of the intermittence and recurrence of glacial action. In regard to this point he recognizes the great value of the labours of British and American as well as Scandinavian and German geologists when compared with those of the majority of their French *confrères*; and, following the lead of our own palæontologists, he refuses to believe that any traces of human existence can be referred to pre-glacial ages, although some may perhaps be assigned to inter-glacial periods; while he considers that in certain northern lands, as Denmark and Southern Sweden, where there is a complete absence of Palæolithic objects, their non-appearance may be explained by the ice-covering not having been entirely removed in these regions till the dawn of the age of polished stone.—The tibia in the Neanderthal race, by Prof. Julien Fraipont. As a further exposition of the views which the author, in concert with M. Lohest, had expressed in regard to the effect on the maintenance of the vertical position of the obliquity and curvature of the femur in the "men of Spy," he now attempts to show, from the observations of others, and his own anatomical experiments, that in this inclination of the head of the femur we have a characteristic common to the anthropoids. An ingeniously devised series of determinations of the variations of the axis of the head of the tibia in recent man, the men of Spy, the gorilla, and other anthropoids, shows the gradual straightening of the axis as we ascend from the latter to existing man, in whom there is a well-marked tendency to the fusion of the axis of the head of the tibia with that of the body. From a careful comparison of the gradual anatomical changes presented in man since his earliest representative appeared in the Quaternary age, M. Fraipont believes we are justified in assuming that the human race has progressively acquired a more and more vertical posture.—On the population of the ancient Pagus-Cap-Sizun, "Cape du Raz," by MM. Le Carguet and P. Topinard. In considering the map of France from an ethnographic point of view, French anthropologists are generally agreed in regarding as specially Celtic the region which includes Brittany, Auvergne, and the entire mass of mountains extending through Central France and Savoy. The population of the eastern portion of this region is more brachycephalic than that of the western, which has been largely affected by admixture with the blonde, tall, dolichocephalic races whose presence is traceable everywhere in Europe, although more definitely the further north we go. This admixture of types is most strongly marked in Brittany, where French is the spoken tongue in Haute-Bretagne, and Breton (apparently a dialect derived from an ancient Kymric language) the predominant tongue in Basse-Bretagne. Among the many interesting localities of the latter region, special attention is due to Pointe du Raz, which, from the nature of its rocky boundaries on the land side, and its position further west than any other in France, has been virtually cut off from communication with the rest of the country, in consequence of which its population presents relatively fewer marks of mixed origin. M. Topinard supplies an interesting report on the geological, historical, and ethnological characteristics of the Cape du Raz district, and thus enhances the value of the series of observations regarding the population of this far west of France which have been supplied by M. Le Carguet, and may be generally summarized as leading to the inference that the "Capiste" race is essentially Breton in regard to the predominance of blue eyes with dark hair, and their generally low stature, these characteristics being associated with a disposition in which courage and energy are blended with strongly marked avarice and a love of greed; while in other respects they show evidence of a strongly-marked Celtic type.—Heredity in political economy, by M. de Lapouge. In this sequel to his former articles on "Inequality among Men," the author urges that it is the duty of the State to use all means at its disposal to eliminate the degenerate, and multiply the favoured elements of which the community is composed. As an ultra-pessimist in regard to the advance of inferior races through civilization, he points to the small effect which thousands of years have effected in the natives of the Black Continent. To him, equality and fraternity are mere delusive terms, based on an insufficient estimate of the force of the immutable laws of Nature, from amongst which we cannot exclude natural selection and survival of the fittest. As the avowed opponent of the doctrine of the amalgamation of types, and the production of permanent hybrids, he proclaims it as his opinion that, if the higher races are not to be exterminated by the lower, they must ally themselves solely with their own dolichocephalic, blonde, Aryan kindred. In treating of the question of selection he passes in review the bearing that religious opinions have had among different races in determining various degrees of consanguinity which were to be recognized as natural barriers against intermarriage among relatives. Considered generally, M. de Lapouge's article is a protest against futile attempts in the assumed name of philanthrophy to raise inferior types at the expense of those whom history from its earliest dawn has shown us to have been the leaders and pioneers in every path of human progress.—In a note on the recurrence among the Provençals of the present day of the myth of Ibicus, M. le Dr. Bérenger-Férand draws attention to the numerous characteristics derived from Hellenic antiquity which are still to be met with on the site of ancient Greek settlements. The modern tale of the detection of a murder through a reference by the murderers themselves to the birds which had been near the spot where the deed was done, is current both at Toulon and La Grasse. Both versions agree closely with the Greek original as to the course of the events, although the myth had been accepted as a true account of a contemporaneous occurrence in the latter place many years before it received its modern names of persons and places from the Toulonais.—In a note on the history of anthropology in 1788, M. Topinard has collected together various interesting details as to the precise meaning attached at that and earlier periods of the last century to the terms anthropology and ethnology. A doubt exists, however, as to the latter term, which is generally believed to have originated in its present sense with W. Edwards, when in 1839 he founded his so-called Ethnological Society. Dr. Topinard derives many curious facts from the manuscript work of Chavannes, Professor of Theology at Lausanne, whose speculative views as given in his writings he believes to have largely influenced the Encyclopædists no less than the author of "Emile."—Report by Dr. P. Topinard on the Neolithic skull, found at Feigneux (Oise) in 1887, which presents undoubted traces of having been trepanned both during life and after death.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 31.—"Colour Photometry. Part II. The Measurement of Reflected Colours." By Captain W. de W. Abney, R.E., F.R.S., and Major-General Festing, R.E., F.R.S.

In a previous paper we showed how the luminosity of different spectrum colours might be measured, and in the present paper we give a method of measuring the light of the spectrum reflected from coloured bodies such as pigments in terms of the light of the spectrum reflected from a white surface. To effect this the first named of us devised a modification of our previous apparatus. Nearly in contact with the collimating lens was placed a double image prism of Iceland spar, by which means two spectra were thrown on the focussing screen of the camera (which was arranged as described in the Bakerian lecture for 1886), each formed of the light which enters the slit. The light was thus identical in both spectra. The two spectra were separated by about ⅛ of an inch when the adjustments were complete. A slit cut in a card was passed through this spectrum to isolate any particular portion which might be required. The rays coming from the uppermost spectrum were reflected by means of a small right-angled prism in a direction nearly at right angles to the original direction on to another right-angled prism. Both prisms were attached to the card. From this last prism the rays fell on a lens, and formed on a white screen an image ofthe face of the spectroscope prism in monochromatic light. The ray of the same wave-length as that reflected from the upper spectrum passed through the lower half of the slit, and falling on another lens formed another image of the face of the prism, superposed over the first image. A rod placed in front of the screen thus cast two shadows, one illuminated by monochromatic rays from the top spectrum, and the other by those from the bottom spectrum. The illumination of the two shadows was equalized by means of rotating sectors which could be closed and opened at pleasure during the time of rotation. The angle to which the sector required to be opened to establish equality of illumination of the two shadows gave the ratio of the brightness of the two spectra. When proper adjustment had been made, the relative brightness was the same throughout the entire spectrum.

To measure the intensity of any ray reflected from a pigment, a paper was coated with it and placed adjacent to a white surface, and it was so arranged that one shadow of the rod fell on the coloured surface and the other on the white surface. The illuminations were then equalized by the sectors, and the relative intensities of the two reflected rays calculated. This was repeated throughout the spectrum. Vermilion, emerald-green, French ultramarine were first measured by the above method, and then sectors of these colours prepared, which when rotated gave a gray matching a gray obtained by rotation of black and white. The luminosity curves of these three colours were then calculated and reduced proportionally to the angle that each sector occupied in the disk. The luminosity curve of the white was then reduced in a similar manner, and it was found that the sum of the luminosities of the three colours almost exactly equalled that of the white. The same measurements were gone through with pale-yellow chrome and a French blue, which formed a gray on rotation, with like results. It was further found that *the sum of the intensities* of vermilion, blue, and green varied at different parts of the spectrum, and the line joining them was not parallel to the straight line which represented white for all colours of the spectrum and which itself was parallel to the base. Since a straight line parallel to the base indicated degraded white, it followed that if the intensity of the rays of the spectrum were reduced proportionally to the height of the ordinates above a line tangential to the curved line (which represented the sum of the intensities of the three colours at the different parts of the spectrum) and were recombined, a gray should result. A method was devised of trying this, and the experiment proved that such was the case. The same plan enabled the colour of any pigment to be reproduced from the spectrum on the screen. The combination of colours to form a gray on rotation by a colour-blind person was also tried, and after the curve of luminosity of the colours had been calculated and reduced according to the amount required in the disk, it was found that the sum of the areas of the curves was approximately equal to the white necessary to be added to a black disk to form a gray of equal intensity as perceived by him. The spectrum intensity of gas-light in comparison with the electric light was also measured, and the amount of the different colours necessary to form a gray in this light was ascertained by experiment.

As before, it was found that the calculated luminosity of the colours was equal to the white which, combined with black, formed a gray of equal luminosity.

The question of the coloured light reflected from different metals was next considered, and the method of measuring it devised, as was also the method of measuring absorption spectra. The luminosity curves obtained by the old method were compared with those obtained by the present method, and so close an agreement between them was found to exist as to give a further confirmation that our former plan was accurate. A number of pigments that can be used for forming grays by rotation were measured, and the results tabulated in percentages of the spectrum of white light and on a wave-length scale.

Physical Society, June 9.—Prof. Reinold, President, in the chair.—The following papers were read:—On the analogy between dilute solutions and gases as regards Gay-Lussac's and Boyle's and Avogadro's laws, by Prof. van 't Hoff, presented by Prof. Ramsay, F.R.S. If a dilute aqueous solution of sugar (say 1 per cent.) be placed in a vessel, A (the walls of which are permeable to water, but not to sugar molecules), and immersed in a large quantity of water, B, water will pass from B to A until a certain difference of pressure exists between the inside and outside of A, that difference depending on the temperature and concentration of the solution. The pressure is called *osmotic pressure*, and the walls of A are said to be *semi-permeable*. Such a vessel may be artificially produced by depositing ferrocyanide of copper on unglazed porcelain; but many of the experiments dealt with in the paper have been made with the cells of plants, the walls of which form good *semi-permeable membranes*. At constant temperature the osmotic pressure is found to be proportional to the concentration of the solution, and for a given concentration the pressure is proportional to the absolute temperature. Similar results have been obtained with solutions of KNO_3, K_2SO_4, NaCl, &c., and Soret has found that if a solution be heated unequally at different parts, the warmer parts are less concentrated, just as in gases under similar conditions the warmer parts are more rarefied. The numerical results are in fair accordance with those deduced from the laws above stated. Theoretical proofs of the laws are given, in which reversible cycles and the second law of thermodynamics are made use of. By similar reasoning the author concludes that "under equal osmotic pressure, and at the same temperature, equal volumes of all solutions contain the same number of molecules, and moreover the same number of molecules which would be contained in a gas under the same conditions of temperature and pressure." These results are confirmed by Pfeffer's direct determinations of osmotic pressure, and Raoult's experiments on the "molecular lowering of vapour-pressure," and the "molecular depression of the freezing-point of the solvent." The latter part of the paper contains applications to chemical phenomena. Prof. Rücker regretted that the names Boyle's law and Gay-Lussac's law had been so persistently made use of in the paper, as he thought a wrong impression would be spread as to the nature of the phenomena. He also considered it probable that the proportionality observed was merely the result of the smallness of the ranges over which the experiments had been made. Mr. H. Crompton took exception to the imaginative character of the reasoning, and thought much more experimental proof was required before the results could be accepted for any but very small ranges of concentration. In answer to Prof. Reinold, Prof. Ramsay said the experimental data were not obtained by van 't Hoff himself, but were taken chiefly from Raoult's determinations.—On a method of comparing very unequal capacities, by Dr. A. H. Fison. One coating of each condenser is joined to earth, and to one end, A, of a high resistance (20,000 or 30,000 ohms), through which a current is flowing. The small condenser is charged to the P.D. existing between the ends A, B, of the resistance, and discharged into the large one. This is repeated a great number of times. If C be a point between A and B, the resistance between A and C may be varied until the P.D. between them is equal to that between the coatings of the condensers after n operations. If the insulated coatings be now joined to C through a galvanometer, no deflection will result. The relation between the capacities C_1 and C_2 of the large and small condensers is given by

$$\left(1 + \frac{C_2}{C_1}\right)^n = \frac{R_{AB}}{R_{BC}},$$

where R_{AB}, R_{BC} are the resistances between AB and BC respectively. Since time is required to perform the operation, the instantaneous capacities cannot be compared, and accordingly the measurements are taken after a definite time of electrification. A special rotating key was shown for performing ten operations per revolution, in which a trigger arrangement was provided for stopping the rotation after a predetermined integral number of revolutions. The method has been used for comparing a small air-condenser with a microfarad. The capacity of the former was also calculated electro-statically (correction being made for the edges), and that of the latter measured electro-magnetically by a ballistic galvanometer. The results give a value for v equal to $2{\cdot}965 \times 10^{10}$. In these experiments the capacity of the rotating key was allowed for. Under favourable conditions, capacities in the ratio of 1 to 1000 or 1 to 10,000 can be compared with an accuracy of ¼ per cent. Prof. Ayrton thought the novelty of the arrangement was in the rotating key, as the method of comparing unequal capacities by charging the smaller and discharging it into the larger a considerable number of times had been described and used by himself and Prof. Perry in their experiments on the specific inductive capacity of gases.—Mr. W. Lant Carpenter exhibited a new form of lantern, recently constructed by Mr. Hughes, of Dalston. The mahogany body is hexagonal, and each of the three front sides is provided with condensers and projecting arrangements. The back side opens to give access to the radiant, which in this case is a Brockie-Pell arc lamp, but if necessary a lime-light can be readily substituted. The lamp is fixed to the base-board, and the body can be rotated through 60° on either side of the central position, thus allowing any of the three nozzles to be directed towards the screen. The three sets of condensers are placed so that their axes intersect at a point about which the radiant is placed. The centre nozzle is fitted as a lantern microscope, with alum cell and various sets of condensing lenses and objectives, and a space in front of the main condensers is provided for polarizing apparatus. The focussing arrangement consists of a skew rack and pinion and a fine screw adjustment, and the whole microscope can be easily removed and a table polariscope substituted. The right-hand nozzle is arranged for the projection of ordinary lantern-slides, and the left-hand one is provided with an adjustable slit for spectrum work. A small table sliding on rails serves to carry the prisms, and the same rails support projecting lenses. Prof. S. P. Thompson congratulated Mr. Lant Carpenter on his selection of the Brockie-Pell lamp as the radiant, for, in addition to its being a focussing-lamp, it is unique in the fact that it works satisfactorily on either constant current or constant potential circuits.—Note on some additions to the Kew magnetometer, by Prof. Thorpe, F.R.S., and Prof. Rücker, F.R.S. In their magnetic survey of Great Britain and Ireland the authors have experienced considerable difficulty in making the necessary adjustments of the small transit-mirror used for determining the geographical N. point from observations on the sun. To make the required adjustments it is necessary to obtain an image of the cross-wires reflected from the mirror; and owing to the large amount of extraneous light, and the insufficient illumination of the cross-wire, the image is difficult to see. To exclude extraneous light, a tube is placed between the transit-mirror and the telescope, and a small screen placed behind the mirror. The cross-wires are illuminated by light reflected from a small platinum mirror introduced between the eye-piece and the cross-wires, which are viewed through a hole in its centre. The mirror is placed at 45° to the axis, and reflects a considerable quantity of light on the cross-wires when directed towards a bright part of the sky. In some cases it is advisable to take observations of the sun without first adjusting the transit-mirror, and afterwards correct the error introduced thereby. To do this a finely-divided scale is placed in the plane of the cross-wires, and from the position of the image, as indicated on the scale, the correction can be made. Observations taken with the mirror in adjustment and others taken when out of adjustment, and subsequently corrected, give very concordant results. The Rev. Father Perry said the improvements described were of great importance, for difficulties similar to those experienced by the authors had caused him to abandon the Kew magnetometer for field work, and to use a theodolite instead.

Linnean Society, June 21.—Mr. F. Crisp in the chair.—Mr. F. W. Oliver exhibited the aquatic and terrestrial forms of *Trapella sinensis*, of which he gave a detailed account, illustrated by diagrams.—Dr. R. C. A. Prior exhibited a branch of the so-called "Cornish elm," and described its peculiar mode of growth, which suggested its recognition as a distinct species. In the opinion of botanists present, however, it was regarded as merely a well-marked variety of the common elm.—On behalf of Mr. R. Newstead, of the Grosvenor Museum, Chester, photographs and drawings of the little grebe, *Podiceps minor*, were exhibited to illustrate a peculiarity observed in the mechanism of the leg-bones.—Mr. A. W. Bennett exhibited under the microscope, and made remarks upon, filaments of *Sphæroplea annulina* (from Kew), containing fertilized oospores.—Mr. Thomas Christy exhibited specimens of natural and manufactured Kola nuts, and explained how the latter might always be detected.—The following papers were then read:—Dr. P. H. Carpenter, on the *Comatulæ* of the Mergui Archipelago.—Prof. P. Martin Duncan and W. P. Sladen on the *Echinoidea* of the Mergui Archipelago.—Mr. W. P. Sladen, on the *Asteroidea* of the Mergui Archipelago.—Mr. W. Bolus, on South African *Orchideæ*.—Mr. R. A. Rolfe, a morphological and systematic revision of *Apostasiæ*.

Geological Society, June 7.—Dr. W. T. Blanford, F.R.S. President, in the chair.—The following communications were read:—A letter from H.M. Secretary of State for India, accompanying some specimens of rubies in the matrix from Burma.—On the Sudbury copper deposits (Canada), by J. H. Collins.—Notes on some of the auriferous tracts of Mysore Province, Southern India, by George Attwood.—On the Durham salt-district, by E. Wilson. In this paper the author described the new salt-field in the North of England, occupying the low-lying country bordering the estuary of the Tees, and situated partly in Yorkshire and partly in Durham. The history of the rise and progress of the salt-industry in South Durham was given, since the first discovery of salt by Messrs. Bolckow, Vaughan, and Co., at Middlesborough, in the year 1859. The stratigraphical position of the saliferous rocks of the Durham salt-district was considered in some detail. The diverse views which have been previously expressed on this head were referred to, and reasons given for concluding that all the beds of rock-salt which have been hitherto proved in this field, and the red rocks with which they are associated, belong to the upper portion of the Trias, viz. to the Upper Keuper series (Waterstones subdivision). The probable area of this salt-field, the limits of the distribution, and varying depths of the chief bed of rock-salt were indicated, and the extent of its supplies pointed out. In conclusion, the author called attention to the waste, as well as to certain other disadvantages resulting from the process of winning the salt now in operation.—On the occurrence of *Calcisphæræ*, Williamson, in the Carboniferous Limestone of Gloucestershire, by E. Wethered.—Second note on the movement of scree-material, by C. Davison; communicated by Prof. T. G. Bonney, F.R.S.

Anthropological Institute, May 29.—Francis Galton, F.R.S., President, in the chair.—A paper by Mr. G. H. Kinahan was read, on rubbings from ancient inscribed stone monuments in Ireland.—Dr. Stewart gave an account of the inhabitants of Paraguay.

June 12.—The Rev. H. G. Tomkins read a paper on Mr. Flinders Petrie's collection of ethnographic types from the monuments of Egypt. The author classified the collection under the four heads of Westerns, Southerns, Asiatics, and Egyptians; and examined, in order, the races mentioned under each of these heads. Among the Westerns are the Tahennu, or fair people, who, as Egyptian mercenary troops, founded, by a prætorian revolt, the famous twenty-second dynasty, to which Shishak, the invader of Palestine, belonged. The Lebu, or Libyans, fall under this head; and the author identifies with them the light-complexioned, fair-haired, and blue-eyed brickmakers of the celebrated tomb of Rekhmara. The want of the long side-locks is not surprising, since they were slaves employed in the lowest drudgery. The Shardina furnished highly-trained soldiers to the Egyptian army of Rameses II. They wore helmets with two horns, crested with a disk, and seem to have been Sardinians. Under the head of Southerns we have very various and interesting types. It is curious to find, in the paintings, blacks with red hair; but it seems probable that the colour was produced by the use of dye. Mr. Tomkins gave a full description of the race of Pûn, and dwelt particularly upon the terraced mountains covered with incense-trees that caused so much astonishment to the officers of Queen Hatasu. He also gave a probable explanation of the origin of the remarkable features of Amenhotep IV., the celebrated Khu-en-aten, whose mother, Queen Tua, was distinguished for her beauty.

Mathematical Society, June 14.—Sir J. Cockle, F.R.S., President, in the chair.—The Vice-Chancellor of Cambridge University (Dr. C. Taylor), read a paper on the determination of the circular points at infinity.—Prof. M. J. M. Hill followed with a paper on the *c*- and *p*-discriminants of integrable differential equations of the first order.—Mr. Tucker (Hon. Sec.), communicated papers by Lord Rayleigh, Sec. R.S., on point-, line-, and plane-sources of sound.—Note on rationalization, by H. Fortey.—Applications of elliptic functions to the theory of twisted quartics, by Prof. G. B. Mathews.—Prof. Greenhill, F.R.S., communicated remarks on coefficients of induction and capacity and allied problems, in continuation of a former paper (January 1879).—The following were taken as read: electrical oscillations, by Prof. J. J. Thomson, F.R.S.; and demonstration of the theorem "that the equation $x^3 + y^3 + z^3 = 0$ cannot be solved in integers," by J. R. Holt.

Zoological Society, June 5.—Dr. Edward Hamilton, Vice-President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of May.—Mr. H. E. Dresser exhibited a specimen of a new Shrike from the Transcaspian district of Central Asia, which he proposed to name *Lanius raddei*, after Dr. Radde, of Tiflis, its discoverer.—Mr. Sclater, on the part of Mr. F. M. Campbell, exhibited a pair of Pallas's Sand-Grouse (*Syrrhaptes paradoxus*), shot in Hertfordshire in May last, and made remarks on the recent immigration of this Central Asiatic bird into Western Europe.—The Secretary exhibited, on behalf of Prof. R. Collett, a nest, eggs, and two young ones in down of the Ivory Gull (*Larus eburneus*), belonging to the Tromsö Museum, which had been obtained in Spitzbergen in August 1887.—Mr. Warren communicated a paper on Lepidoptera collected by Major Yerbury in Western India in 1886–87, forming a continuation and completion of two previous papers by Mr. A. G. Butler on Lepidoptera collected by the same gentleman in similar localities. The present collection contained examples of over 200 species of Heterocera, of which about one-fourth were described as new. Mr. Warren remarked upon the abnormal development of separate organs, such as the antennæ and palpi, in tropical insects, as being rather specific aberrations from a generic type, than as warranting the erection of new genera.—A communication was read from Mr. Martin Jacoby, containing descriptions of some new species of Phytophagous Coleoptera from Kiukiang, China.—Mr. F. E. Beddard read some notes on the structure of a peculiar sternal gland found in *Didelphys dimidiata*.—Mr. G. A. Boulenger read a paper on the scaling of the reproduced tail in Lizards, and pointed out that the scaling of the renewed tails of Lizards may, in some cases, afford a clue to the affinities of genera or species to one another.—Mr. F. E. Beddard gave a preliminary notice of an apparently new form of Gregarine, found parasitic on an earthworm of the genus *Perichæta* from New Zealand.

CAMBRIDGE.

Philosophical Society, May 21.—Mr. J. W. Clark, President, in the chair.—On solution and crystallization, by Prof. Liveing. When a substance passes from a state of solution into the solid state, the new arrangement of the matter must be such that the entropy of the system is a maximum; and, other things being the same, the surface energy of the newly formed solid must be a minimum. If the surface tension be positive, that is tend to contract the surface, the surface energy will be a minimum when the approximation of the molecules of the surface is a maximum. The essential difference between a solid and a fluid is that the molecules of the former maintain approximately the same relative places, whereas the molecules of a fluid are subject to diffusion. Further, crystalloids in assuming the solid form assume a regular arrangement of their molecules throughout their mass, which we can usually recognize by the optical properties of the crystal, and by the cleavage. If we suppose space to be divided into equal cubes by three sets of parallel planes, each set at right angles to the other two, and suppose a molecule to be placed in every point where three planes intersect, we shall have an arrangement which corresponds with the isotropic character of a crystal of the cubic system. But of all the surfaces which can be drawn through the system the planes bounding the cubes meet the greatest number of molecules, those parallel to the faces of the dodecahedron meet the next greatest number of molecules, and those parallel to the faces of the octahedron meet the next greatest number. Also if we take an angular point of one of the cubes as origin, and three edges of the cube as axes, and the length of an edge of the cube as the unit of length, every plane which cuts the three axes at distances p, q, r respectively from the origin, where p, q and r are whole numbers, will be a surface of maximum concentration of molecules, but the concentration will be less as p, q and r are greater. Hence forms which are bounded by these planes, which follow the law of indices of crystals, will be forms of minimum surface energy and therefore of equilibrium. The tendency in general will be for substances with such a structure as is here supposed to take the form of cubes, since the cube will have the greatest concentration of molecules per unit of surface. But the total surface energy will depend on the total surface as well as on the energy per unit of surface, and for a given volume the surface will be diminished if the edges and angles of the cube are truncated by faces of the dodecahedron and octahedron, or by more complicated forms. When a solid is broken, two new surfaces are formed each with its own surface energy, and the solid must be more easily fractured when the new surfaces have the minimum energy. Hence substances with the structure supposed must break most easily in directions parallel to the sides of the cube, dodecahedron and octahedron; and these are the cleavages observed in this system. If we suppose the molecules placed at the centres of the faces of the cubes, instead of at the angles, the arrangement will still be isotropic, but the octahedron will be bounded by the surfaces of greatest condensation, and the cube will come next to it. It is probable that substances which cleave most readily into cubes, such as rock-salt and galena, have the former structure, while those which have the octahedral cleavage may have the latter arrangement of their molecules. For the pyramidal and prismatic systems we may suppose space divided not into cubes but into rectangular parallelopipeds with edges equal severally to the axes of the crystals, and molecules placed as before. For the rhombohedral system we may suppose space divided into rhombohedra, or in crystals of the hexagonal type into right prisms with triangular bases, and for the other systems into parallelopipeds with edges parallel and equal to the axes. In each case if the molecules be disposed at points of intersection of three dividing planes we shall have such an arrangement as satifies the optical conditions, and planes which follow the law of indices are surfaces of maximum condensation. Calculations show that whenever a crystal has an easily obtained cleavage the direction of cleavage corresponds to the surface of greatest condensation, and that the most common forms of crystals correspond in general to forms of minimum surface energy. The surface tension of a plane surface will have no resultant out of that plane, but where two plane surfaces meet in an edge, or angle, the tensions will have a resultant of sensible magnitude in some direction falling within the angle. Whenever all the faces of a crystallographic form are developed, every such resultant will be met by an equal and opposite resultant, and the form will be one of equilibrium. If one edge, or angle, be modified, the opposite edge, or angle, must either be similarly modified, or the resultant arising from the modification must be equilibrated by some internal forces produced by displacement of the molecules. In general, equilibrium is attained by similar modifications of similar edges and angles, but when only some of the edges or angles of a crystal are modified, while other similar edges or angles are not modified, we usually have evidence of the consequent internal strain. Thus cubes of sodium chlorate, which have half the angles truncated by faces of a tetrahedron, rotate the plane of polarized light, hemihedral tourmalines are pyro-electric, and so on. This theory therefore accounts for the plane faces of crystals, the law of indices, the most common combinations, and the cleavages. The same theory accounts for the development of plane faces when a crystalline solid of any shape is slowly acted on by a solvent. Solution will proceed so long as the entropy of the system is increased by the change, but when the solution is nearly saturated there will be an increase of entropy from the solution of a surface which has more than the minimum surface energy, while there will be no increase from the solution of a surface which has only the minimum energy.—On the effect of an electric current on saturated solutions, by Mr. C. Chree, M.A. This paper contains an account of experiments whose aim was to determine what effect, if any, an electric current may have on the quantity of salt required to form a saturated solution. Strong currents and a rapidly reversing commutator were employed. Certain chlorides were dealt with, and in no case did the existence of a current produce any sensible immediate effect. When heating was allowed to take place, the action of the current appeared to check the solution that would naturally have followed. This view was further supported by experiments on the effects of simple heating. These experiments showed, however, that an originally saturated solution when slowly heated can dissolve salt only with extreme slowness.

PARIS.

Academy of Sciences, June 18.—M. Janssen, President, in the chair.—Lagrange's hypothesis on the origin of comets and meteorites, by M. H. Faye. According to the author's calculations, this hypothesis, first submitted to the Bureau of Longitudes in 1812, does not hold good for the comets whose orbits do not quite approach any of the planetary orbits. But it would seem capable of being applied to the meteorites, whose fragmentary character, minute size, chemical and mineralogical identity with the constituent elements of the earth, combined with their great abundance, would seem to be absolutely incompatible with an extra-planetary origin. The earth alone with its satellite best satisfies all the conditions of the problem, while its orbit is continually intersected by millions of these bodies, as required by the hypothesis in question. Hence their origin is to be sought in the earth itself and in the moon, whence they were ejected under conditions which have long ceased to exist.—Fluorescence of ferruginous lime, by M. Lecoq de Boisbaudran. These experiments show that a small quantity of the sesquioxide of iron added to the carbonate of lime produces a green fluorescence after high calcination in the air. This fluorescence, which is occasionally somewhat intense, is very sensitive to the action of heat; hence it soon fades away in the presence of the electrode, retaining its brilliancy only in the parts of the tube furthest removed from the centre of action.—Experimental researches on the diseases of the vine, by MM. Pierre Viala and L. Ravaz. Having already shown that the different reproductive organs found on the parts affected by black rot belong to the fungus, cause of this disease, the authors here demonstrate the true parasitic character of the fungus itself. They once for all establish the filiation which exists between its various forms of reproduction, and thus make it evident that the blight on the leaves has the same origin as that of the grapes.—Researches on the accidental errors occurring in the observations of transits made by the method of eye and ear, by M. G. Rayet. In supplement to the studies of Struve, Robinson, Dunkin, Finlay, and others, the author here describes the results of special observations made on about seventy stars, or constellations, comprised between 20° of austral declination and the North Pole. He has thus determined the numerical value of the accidental errors relative to some dozen stars between 80° and 89° 22′·3 of declination.—On the rings of Saturn, by M. Perrotin. During the opposition of Saturn in the present year the author has made a series of micrometric measurements of the rings by means of the great equatorial of the Observatory of Nice. The results of these observations, made for the purpose of determining the dimensions of the system, are here fully tabulated for the whole period from February 2 to May 8.—On the planet Mars, by M. Perrotin. On presenting the already promised sketches of recent appearances in this planet, the author remarked that since his last communication the region of Libya has undergone fresh modifications. The sea which covered the surface of this insular mass has mostly receded, its present appearance being intermediate between that of 1886 and its condition a few weeks ago. The existence has also been determined of canals or channels, partly double, running from near the equator to the neighbourhood of the North Pole. They mainly follow the meridian, and merge in the seas encircling the white snow-cap of the Pole, and, strange to say, their course may be followed across the seas themselves right up to the snow-cap.—Heat of combination of the primary, secondary, and tertiary aromatic monamines with the acids, by M. Léo Vignon. In continuation of M. Louguinine's study of the primary monamines, the author here investigates the reactions of several acids on a series of primary, secondary, and tertiary monamines. He deals more especially with aniline, monomethyl aniline, and dimethylaniline in the presence of the hydrochloric, sulphuric, and acetic acids.—On the decomposition of the ferrate of baryta at high temperatures, by MM. G. Rousseau and J. Bernheim. In his researches on ferric acid, Fremy has indicated the analogy existing between the ferrates and the manganates, as established by the wet process. Here the authors endeavour to ascertain whether the parallelism is maintained in the reactions of the dry process and in their mode of decomposition under the action of heat.—On some new double phosphates in the magnesian series, by M. L. Ouvrard. The products here described have been obtained by the method already referred to in a previous note on the action of the alkaline phosphates on the alkaline earthy oxides. All the metals investigated are allied in their composition to the substances obtained with the pyro- and ortho-phosphates of potassa and soda.—On the poison of the Hymenoptera with smooth sting, and on the existence of a poison-cell in the honey-producing insects, by M. G. Carlet. In continuation of his researches on the barbed sting of bees, wasps, &c., the author here studies the smooth sting of Philanthus, Pompilus, &c. He describes the nature of the poison, which has merely a soporiferous effect, and clearly determines the presence of a poison-cell in bees and allied insects.—On a new bacterial disease of the duck, by MM. Cornil and Toupet. An examination of the bacteria of this disease ("duck cholera") shows that it is quite distinct from chicken cholera. The virus is fatal to the duck alone, sparing hens and pigeons, and killing rabbits only when an excessive dose is administered.—M. A. d'Arsonval contributes an elaborate paper on the relation between animal electricity and surface tension.

AMSTERDAM.

Royal Academy of Sciences, May 26.—M. Franchimont, communicating the results of experiments on nitro-ureides and nitramines, said that internal ureides, by their behaviour with nitric acid, may be distinguished into at least three sorts.—M. Sahols treated of the calculation of the moments of flexion and the shearing-forces in railway-bridges, in connection with the irregular distribution of the pressures exercised by the axles of locomotive-engines. He pointed out what elements of the engine are of especial influence on these, and arrived at very simple approximative formulæ for the calculation of the said moments and forces on bridges of not too insignificant length.—M. Pekelharing read a paper on the proliferation of endothelium-cells in arteries, stating, as the result of his experiments made upon them, that this proliferation is most probably caused by a diminution of the pressure upon the inner wall of the arteries.—M. van der Waals treated of the connection between the change in the density of the limiting layer between fluid and vapour, and the mode of action of the molecular forces.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Proceedings of the Royal Society of Edinburgh, Sessions 1883 to 1887 (Edinburgh).—Transactions of the Royal Society of Edinburgh, vol. xxx. Part 4, vol. xxxii. Parts 2, 3, 4, vol. xxxiii. Parts 1, 2 (Williams and Norgate).—Transactions of the Royal Society of Edinburgh, vol. xxxi. Botany of Socotra: Prof. I. B. Balfour (Williams and Norgate).—British Reptiles and Batrachians: C. C. Hopley (Sonnenschein).—Anleitung zu Wissenschaftlichen Beobachtungen auf Reisen, Bands 1 and 2: Dr. G. Neumayer (Oppenheim, Berlin).—Mathematical Drawing Instruments, sixth edition: W. F. Stanley (Spon).—Proceedings of the American Association for the Advancement of Science, New York Meeting, 1887 (Salem).—British Dogs, Parts 17 to 20: H. Dalziel (U. Gill).—Observations made at the Hong Kong Observatory in the year 1887: W. Doberck (Hong Kong).—Synopsis of the Aphididæ of Minnesota: O. W. Oestlund (St. Paul).—Report on Botanical Work in Minnesota for the year 1886: J. C. Arthur (St. Paul).—Preliminary Description of the Peridotytes, Gabbros, Diabases, and Andesytes of Minnesota: M. E. Wadsworth (St. Paul).—Palæolithic Man in Eastern and Central North America (Cambridge, Mass.).—Journal of the Royal Microscopical Society, June (Williams and Norgate).—Proceedings of the Society for Psychical Research, June (Trübner).—Sulla Forza Elettromotrice del Selenio, Memoria del Prof. A. Righi (Padova).

CONTENTS.

PAGE
The Early Correspondence of Christian Huygens. By **A. M. Clerke** 193
Norwegian Geology 194
Travels in Arabia Deserta 195
Our Book Shelf:—
"Charts showing the Mean Barometrical Pressure over the Atlantic, Indian, and Pacific Oceans" 196
"Commercial Mathematics" 196
Beatty-Kingston: "A Wanderer's Notes" 196
Letters to the Editor:—
The "Sky-coloured Clouds" again.—**T. W. Backhouse** 196
Earth Pillars in Miniature.—**Cecil Carus-Wilson** . 197
Egg-masses on *Hydrobia ulvæ*.—**Prof. W. A. Herdman** 197
Interpretation of the Differential Equation to a Conic. —**R. B. H.** 197
The Nephridia of Earthworms.—**Prof. W. Baldwin Spencer** 197
Strange Rise of Wells in Rainless Season.—**Baldwin Latham** 198
The Opening of the Marine Biological Laboratory at Plymouth. (*Illustrated.*) 198
Personal Identification and Description. II. (*Illustrated.*) By **Francis Galton, F.R.S.** 201
A Magnificent Meteor. (*Illustrated.*) 203
Notes 203
Our Astronomical Column:—
Rotation Period of the Sun from Faculæ 206
Astronomical Phenomena for the Week 1888 July 1–7 207
Geographical Notes 207
Diffraction of Sound. (*With Diagrams.*) By **Lord Rayleigh, F.R.S.** 208
Scientific Serials 211
Societies and Academies 212
Books, Pamphlets, and Serials Received 216